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THE REAL-BALANCE EFFECT WITH RESOURCE-USING
MONEY: A CAPITAL-THEORETIC INTERPRETATION

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THE REAL-BALANCE EFFECT WITH RESOURCE-USING MONEY:
A CAPITAL-THEORETIC INTERPRETATION*

1. INTRODUCTION

Over three decades ago Pigou (1943) introduced the real balance effect in order to buttress the classical model of the stationary state against the attack by Hansen and Keynes. Since then much has been written on virtually every facet of the real-balance effect. In nearly all of this work, as with much of monetary theory, the money stock was treated as a fixed quantity of nominal fiat money.^{1/} The real balance effect in the case of privately produced resource-using money has not been treated. It seems that this case is particularly important, given the increasing awareness that even deposit money requires real production and/or maintenance costs.^{2/}

It is the purpose of this paper to analyze the real-balance effect when money production uses resources. This analysis will be undertaken within the context of a capital-theoretic interpretation of the real-balance effect along the lines of Hynes (1974). Within the context of this interpretation, it will be shown that the equilibrating process of the real-balance effect implies something not only about the shape of the aggregate demand schedule, as traditional analysis suggests, but about the position of the aggregate demand schedule and the shape of the aggregate supply schedule as well.

The analysis is carried out in the model in which the debate first appeared--the classical stationary state. It should be clear, however, that the arguments apply equally well to a standard general equilibrium model. The paper begins with a brief capital-theoretic interpretation of the Pigou effect, in an economy with a fixed quantity of fiat money.

2. A CAPITAL THEORETIC INTERPRETATION OF PIGOU

Pigou argued for the real-balance effect in the classical model of the monetary economy. In this model, output of capital goods and consumer goods is produced using two homogeneous factors of production -- labor and nondepreciating capital. Both factor and product markets are assumed to be competitive and production technologies are assumed to exhibit constant returns to scale and diminishing marginal productivity. Money is assumed to be noninterest-bearing, nonresource-using paper currency of a fixed nominal quantity. The population and labor force are congruent and represent a nonaugmentable factor of production. The representative man is assumed to maximize a utility function of present and future consumer goods which he discounts at a constant rate of time preference which, following convention, is assumed to be zero. Given these assumptions, the long-run classical stationary-state equilibrium is defined by the conditions

(1) $r_k = \delta = 0$,

where r_k and δ denote the marginal return to a labor unit of capital and the representative man's rate of time preference, respectively.

That is, the classical economists believed that, given a stock of human capital and technology, society would expand its stock of nonhuman capital up to the point where the return to the last additional unit to the capital stock is equal to the rate at which society discounts future consumption. At this point, the actual and desired stocks of nonhuman capital coincide and there is no incentive for further wealth accumulation to take place -- stationary-state equilibrium is achieved.

Hansen (1941) questioned the existence of the classical stationary state in terms of the familiar circular-flow analysis of macroeconomics. He reasoned that there is nothing in the classical model which guarantees that actual and desired rates of wealth accumulation be equal when the conditions in (1) are satisfied. Specifically, he argued that if savings yield an amenity flow distinct from the amenity flow obtained from future consumption that can be obtained from present increments to the stock of capital, then savings will exceed investment at the level of output consistent with the conditions in (1). Hansen's logic implies that the full-employment, stationary-state level of output cannot be achieved, at least not at a positive interest rate.^{3/} Thus, Hansen's position is tantamount to arguing that no position of long-run equilibrium can be obtained in this model.^{4/}

Pigou's contribution came in noting that, in the world envisioned by the classical, society as a whole can accumulate wealth only in two forms, real capital and real money. If, hypothetically speaking, the capital stock is expanded to the point

where the rate of return on real capital is driven to zero, while the nonpecuniary return to increments to individual's wealth is positive (i.e., full-employment savings exceeds investment), individuals will choose to hold increments to their wealth in the form of money. Since the pecuniary return to increments to the stock of real capital is negative while the same return is zero (by assumption) for increments to the stock of real money, individuals will obviously opt for the latter; money will yield the same nonpecuniary return as capital and a larger pecuniary return.^{5/}

Individuals temporarily forego current consumption to augment their stock of real money. The demand for goods vis-a-vis money falls, the price level declines and the real money stock expands. As the real money stock expands, the nonpecuniary return to money falls due to the Pigouvian assumption of diminishing marginal utility to wealth.^{6/} Money capital is accumulated until the return to the last unit of real money, r_m , is zero. At this point, no further accumulation of real money or real capital takes place. The long-run, stationary-state equilibrium is achieved. The conditions for long-run equilibrium are:

$$(1') \quad r_k = r_m = \delta = 0.$$

Thus, as the price level falls, aggregate demand for goods and services increases. The rate at which individuals are willing to forego current consumption to increase their holdings of real balances decreases as the real money stock expands. Eventually a point of long-run equilibrium is achieved where aggregate demand equals aggregate supply. This point is depicted by the intersection

of $A_g D_1$ and $A_g S$ in Figure 1. The Pigou effect argues that the aggregate demand curve eventually equals aggregate supply at a positive price level, rather than intersecting the income axis at a point below full-employment, as Hansen's analysis suggest (Hansen's conclusion is graphically depicted by $A_g D_2$ in Figure 1).^{7/}

3. PIGOUVIAN ANALYSIS AND RESOURCE-USING MONEY

The analysis of the previous section is extended to the case of competitively produced, resource-using money. Resource-using money is assumed to be a commodity in the sense of being a physical good like gold; however, it is assumed to function only as a medium of exchange, a store of wealth, and a unit of account.

Nondepreciating real capital and goods, x ,^{8/} and nominal money, M ,^{9/} are produced via the following production functions.

$$x = f(k_x)$$

$$M = M(k_M)$$

Where k_M and k_x denote the amounts of capital per unit of labor devoted to the production of money and real output, respectively.

The homogeneous capital stock can serve as an input in either output or money production. When capital is employed in one use, it cannot be employed in the other; nonetheless, it is freely mobile between alternative uses.^{10/} The population and the labor force are

assumed to be congruent and fixed in size. The stationary-state equilibrium now requires that the conditions in (1'') are satisfied:

$$(1'') \quad r_{kM} = r_{kx} = r_m = \delta = 0,$$

where r_{kM} and r_{kx} are the marginal returns to a labor unit of capital employed in the production of money and output,

respectively. Of course, when r_{kM} and r_{kX} are equal to zero, the production of resource-using money and real capital cease and all output is consumed.

At this point, it is tempting to return to Hansen's hypothetical scenario where the return to real capital is driven to zero while the nonpecuniary return to money is still positive. But, clearly, this result is impossible. The rate of return for producing an additional unit of nominal money (and real money at existing prices) cannot be zero unless the rate of return to the holding of a marginal unit of the money stock is also zero. As long as the nonpecuniary return to the stock of money is greater than zero, individuals value increments to the stock of real money more than the consumption they must temporarily forego to obtain it. This means, of course, that (at the current price level) the return associated with producing one more unit of nominal money must exceed the value of the resources used to produce it.^{11/} Thus, there is an incentive for money producers to augment the stock of nominal money. But this requires capital inputs and, hence, the marginal return to capital cannot possibly be zero. This point has a rather interesting implication for the adjustment process of the real balance effect, as we shall now point out.

Salient Features of the Stationary State

The conditions in (1'') are static and as such state only the requirements for long-run, stationary-state equilibrium. They say nothing about the exact movement of the economy toward long-run equilibrium. This movement depends on the relative speeds of

adjustment of prices, interest rates, nominal money and real output. The exact nature of this adjustment process cannot be deduced from this model.^{12/} Of course, this is equally true in the case of nonresource-using money; although, given the nature of Hansen's criticism, starting from a point where the marginal return to capital is zero seemed natural enough. In the case of resource-using money, however, we will be content with pointing out the more salient features of the stationary state.

First, it is impossible for the return on capital in goods production to be zero without the return to capital in money production also being zero. If this were not the case, capital could be reallocated from the production of goods to the production of money. This would lower the return on capital devoted to money production and raise the return on capital devoted to goods production. This process would continue until equilibrium is restored. Likewise, r_{kM} cannot be zero without r_m being zero. As long as society values an increment to its stock of wealth (either real money or real capital) more than the consumption it must temporarily forego to obtain it, it will be advantageous to allocate resources to the production of money.

Second, the production of money and capital cease when equilibrium is achieved. If one assumes that the production technology is the same in this case as in the case of nonresource-using money and if tastes and preferences are assumed to be the same, the equilibrium stock of real money must also be the same.

However, neither the price level nor the equilibrating force of the real-balance effect need be the same.

In the case of nonresource-using money, the nominal stock of money is fixed and the price level adjusts. In the case of competitively produced resource-using money, both prices and the nominal money stock are endogenous. Equilibrium can be established not only as a result of increases in the quantity demanded as the price level falls and real money balances increase, but also as a result of increases in aggregate demand which may result from increases in the nominal stock of money.^{13/}

The implications of the above analysis for the capital-theoretic interpretation of the real-balance effect are straightforward. If individuals desire to increase their holdings of wealth more than the consumption they must temporarily forego to obtain it, they must acquire wealth in the forms of real money or real capital. As mentioned above, it is impossible to determine the exact nature of the adjustment process for a general model of this form; however, it is clearly inappropriate to start from a place where $r_{km} = 0$ and $r_m > 0$. It is sufficient to note that money capital will be accumulated as long as the return to holding the last real unit of money is positive. As a result of this, there will be an incentive for money producers to expand their output of nominal money. Therefore, the aggregate demand curve not only slopes downward as the price level falls as individuals temporarily reduce current consumption to augment their holdings of real money balances, as the standard interpretation of the real-balance effect

suggests, but the aggregate demand curve shifts to the right with the increase in the stock of nominal money. As society's stock of wealth increases, the nonpecuniary return to wealth falls due to the Pigouvian assumption of diminishing marginal utility of wealth. This is illustrated by the aggregate demand and aggregate supply curves presented in Figure 2. $A_g D_1$ and $A_g S$ are identical to the corresponding curves in Figure 1.^{14/} $A_g D'_1$, however, is drawn on the assumption that the nominal stock of money expands as the price level falls--a possible outcome in the case of resource-using money.

Depreciation and Resource-Using Money

One additional aspect of the real-balance effect should be considered. This is the possibility of a permanent adjustment in aggregate supply as the system moves toward the stationary state. This possibility arises if resource-using money is allowed to depreciate (the assumption of nondepreciating real capital will be retained for simplicity).

For convenience, we assume that resource-using commodity money depreciates at the constant exponential rate, λ . Once this condition is imposed, the assumption of zero pecuniary returns to money must be dropped. Nominal money now yields a gross pecuniary return, $-\lambda$. Thus, the equilibrium conditions are now given by (1'''):

$$(1''') \quad r_{kM} = r_{kX} = r_m - \lambda = \delta = 0.$$

The nonpecuniary return from holding an additional unit of money is reduced by its pecuniary return.^{15/} With this modification, the

previous results of this section remain valid with one important difference. The equilibrium aggregate supply may be less in this case than in the case of nondepreciating resource-using money.

This is easily demonstrated by noting that in final equilibrium not all resources are used to produce consumable output. Some resources are needed to maintain the nominal money stock constant. If the nominal money stock expands as the system moves toward equilibrium, the amount of resources required to maintain the stock increase and, hence, fewer resources are available to produce goods and services. As a result, the system may move toward equilibrium not only via the changes in aggregate demand illustrated in Figure 2, but also as a result of a decrease in the quantity of output supplied.^{16/} This possibility is depicted in Figure 3. $A_g S_1$ corresponds to aggregate supply for nondepreciating resource-using money and $A_g D_1$ and $A_g D_2$ are identical to the corresponding curves in Figure 2. $A_g S_2$ depicts aggregate supply for the case of depreciating money, and is drawn on the assumption that the nominal stock of money increases as the price level falls.

Thus, equilibrium is established not only because of increases in demand and the quantity demanded as society attempts to accumulate wealth, but also because the quantity of goods and services which the economy is able to continuously supply decreases as the stock of nominal money increases.

This conclusion depends critically on the substitutability of labor and capital in money production. If labor and capital are

perfect substitutes so that all money production could be achieved with capital only, then the aggregate supply curve would be vertical. The steady-state capital stock would simply be larger.^{17/} In the absence of perfect factor substitutability, the slope of the aggregate supply curve, $A_g S_2$, depends on three additional factors. First, it depends on the speed with which nominal money output adjusts relative to the other variables, especially the price level. For instance, if prices adjust very rapidly to conditions of falling demand, then the real money stock may increase with a correspondingly small change in the nominal money stock. This would result in a small transfer of resources from goods and services to nominal money stock maintenance and a correspondingly small decrease in output supplied.

Second, the slope of the aggregate supply curve depends on the capital technology required in money production. For example, if money production is labor rather than capital intensive, the impact on aggregate supply will be larger. As the system moves toward equilibrium, output of nominal money expands and labor resources are drawn away from the production of goods and the marginal productivity of capital in the production of goods falls.^{18/} On the other hand, if money production is capital intensive, the capital stock will expand until r_{kM} is equal to zero. At this point, the increase in the amount of labor required to maintain the larger nominal money stock is smaller and there is less of an impact on long-run output.

Third, the slope of aggregate supply depends on the rate of

depreciation; being flatter the higher the rate, *ceteris paribus*.

Before concluding, an additional observation should be made. One could argue that the reduction in aggregate supply, alluded to in this section, actually results from an inappropriate definition of income. For example, if income were defined to include the present value of the flow of nonpecuniary services from money, aggregate supply would not decrease as the nominal stock of money expands. Indeed, this idea forms the basis for Bailey's (1971) criticism of the real-balance effect.^{19/} This is unquestionably true, however, it merely camouflages the real issue. It remains true that commodity output may fall as the system moves toward equilibrium. If this happens, there will be a change in the value of commodities vis-a-vis money, i.e., the price level will change. This price level adjustment is the quintessential feature of the real balance effect, for it alters the stock of real money and, hence, the nonpecuniary return to money capital.

4. SUMMARY AND CONCLUSIONS

This paper presented a capital-theoretic interpretation of the real-balance effect in a model where money production requires inputs of labor and capital, within the context of a model of the classical stationary state. It was shown that if money and capital do not depreciate, then the real-balance effect implies something about the position of the conventional aggregate demand schedule as well as its about shape. Furthermore, if resource-using money depreciates, then the equilibrating process of the real-balance effect may imply something about the shape of the aggregate supply

curve. It is the combined responses of aggregate demand and aggregate supply which constitute the real-balance effect when money production requires real resources.

While the conclusions of this paper pertain directly only to the classical model, it is clear that the analysis has implications for the analysis of the real-balance effect in an integrated general equilibrium model such as Patinkin's (1965). When the price level is insufficient to equilibrate the market, in addition to the portfolio adjustments of households, money producers adjust their output and, therefore, factor utilization until the equilibrium price level is achieved. Thus, there are adjustments on the supply side in addition to the adjustments on the demand side that form the equilibrating process of the real-balance effect.

Because this analysis relies on a nonstandard, capital-theoretic interpretation of the real-balance effect, undoubtedly there will be debate over whether it says something about the real-balance effect per se, or merely about the equilibrating process of a commodity money system. However, if one accepts the capital-theoretic interpretation of Pigou expressed here, and elsewhere by Hynes (1974), there can be no doubt that the equilibrating process of the real-balance effect is more complex than commonly thought if money is resource using.

FOOTNOTES

*I would like to thank Lawrence Davidson and Stanley Fischer for their helpful comments. Of course, I am solely responsible for any errors.

¹Some exceptions are Pesek and Saving (1967), Patinkin (1965).

²For example see Saving (1976).

³For a good discussion of this, see Patinkin (1948).

⁴Pigou (1943, p.346) notes that the interest rate must be the same regardless of the commodity in which it is expressed. Thus, so long as there exists an asset which suffers little wear and tear and has negligible holding costs, the equilibrium interest rate can never be negative. Pigou explicitly assumes this to be the case for money.

⁵At this point this analysis differs from the fine work of Hynes (1974) in one respect. Hynes states that Pigou assumes that real money balances yield these amenity services. I can sympathize with this interpretation, since in the initial reading of Pigou I reached the same conclusion. However, it is clear from this analysis that this is not an assumption but the inevitable result of the fact that society as a whole can accumulate real wealth only in the forms of real capital or real money.

⁶A. C. Pigou (1943, pp. 348-50).

⁷In terms of traditional IS-LM analysis, Hansen's scenario implies the IS curve would intersect the real income axis at below full employment income. Falling prices will shift the LM curve rightward, but will not achieve full employment. With the real-balance effect, savings decline as real wealth expands due to falling prices, so that both the IS and LM curves shift rightward as the price level falls. Thus, the aggregate demand curve is shaped as A_gD_1 .

⁸Output here is the traditional definition, and includes neither the output of money nor the nonpecuniary service flow from the stock of money. More will be said about this at the end of Section Three.

⁹Money producers can only produce nominal units unless the value of the commodity money vis-a-vis output is fixed.

¹⁰A model similar to this was considered by Fischer (1972). In his model, however, there is no transformation of labor and capital in the production of money. Production capital is merely laid aside to provide currency services. Money, capital and output are physically the same commodities; hence, there is no possibility of a relative price change, i.e., a real-balance effect.

¹¹It is clear that the price level in this system will have some of the characteristics of a barter system, in that the money price of output will be determined, in equilibrium, by production technologies, see Sargent and Wallace, (1983).

¹²It should be noted, however, that there is a unique, perfect-foresight (rational expectations) solution for the path of prices.

¹³The proposition that the position of aggregate demand depends on the size of the nominal money stock is hardly new. In the nonresource-costing case, the price level can be determined by setting the nominal stock at the desired level.

¹⁴ $A_g D_1$ in Figure 2 was taken to be identical to $A_g D_1$ in Figure 1 for convenience. It is not meant to imply that the equilibrium nominal stock of money in the resource-using case must be more or less than the nominal stock in the nonresource-using case.

¹⁵Pigou assumes that the return on money could never be negative on the proposition that "money can be held without appreciable cost." Pigou (1947, p. 185). When money depreciates, this condition is not necessarily true. We ignore this problem for simplicity.

¹⁶Of course, this conclusion does not depend on real production costs being related to nominal money production. Competitive equilibrium requires that real marginal (and in long-run, average) costs equal real marginal revenue (M/P). Therefore, any change in the real value of money implies a change in real production costs. It makes no difference if the money production function is written as $M = M(k_M)$ or $(M/P) = g(k_M)$. The implications for the shape of the aggregate supply curve will be the same in both cases. See Thornton (1983).

¹⁷Fischer (1972) has also obtained this result.

¹⁸If $\delta = 0$, then in equilibrium the rental rate on capital is zero and, hence, it is not rationed. If capital depreciated, however, then it commands a positive rental rate. Thus, if the capital intensity of money production is much lower than the capital intensity of goods and production, the movement to long-run equilibrium would be further hastened as labor is transferred to maintain a larger money stock, thereby increasing the capital intensity of goods production.

¹⁹Bailey (1971) has argued that income, correctly defined, should include the imputed value of the nonpecuniary services of money. Then he argues that there is no reason to believe that an increase in wealth associated with "willingly held" money balances should alter one's APC.

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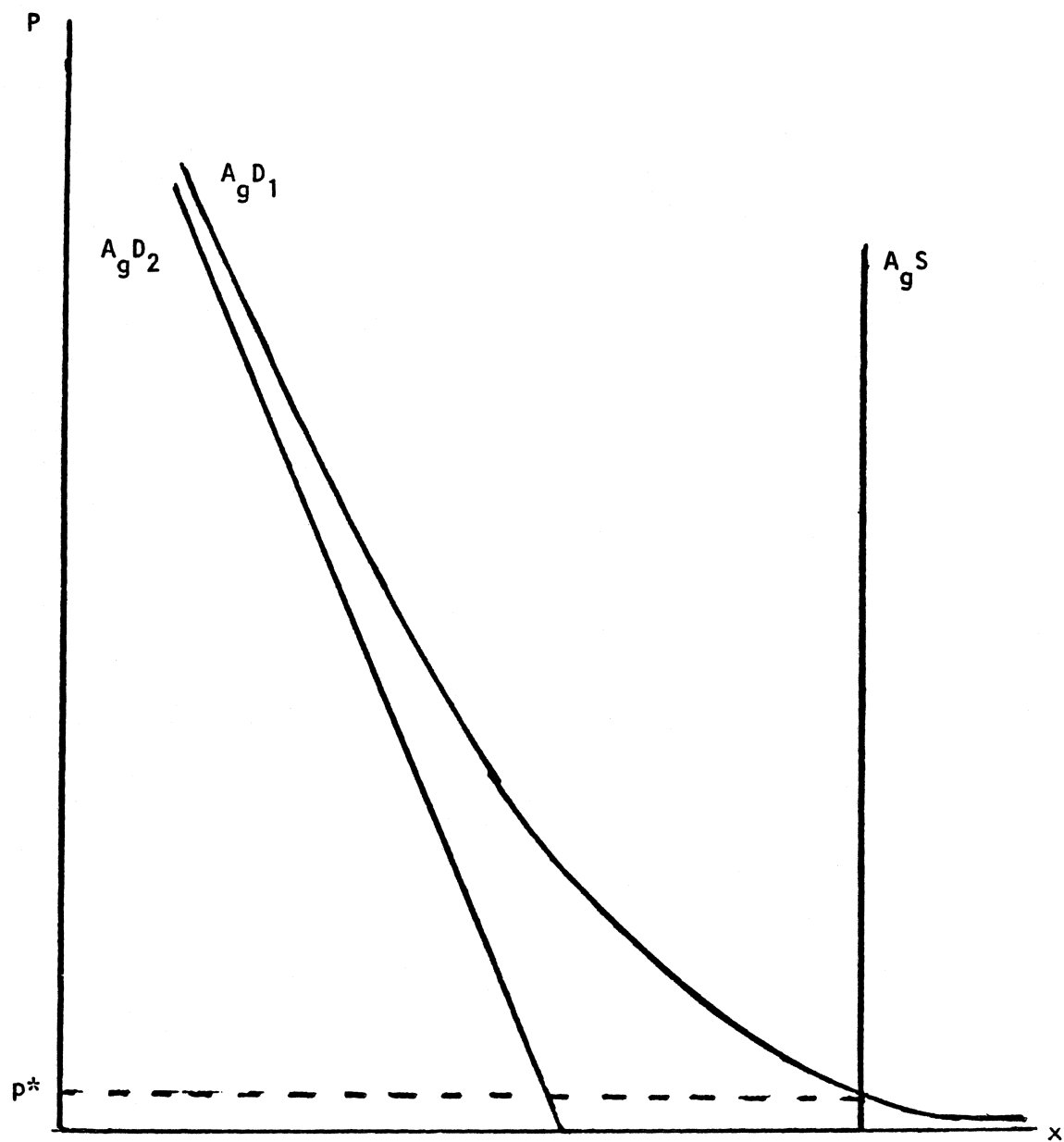


Figure 1

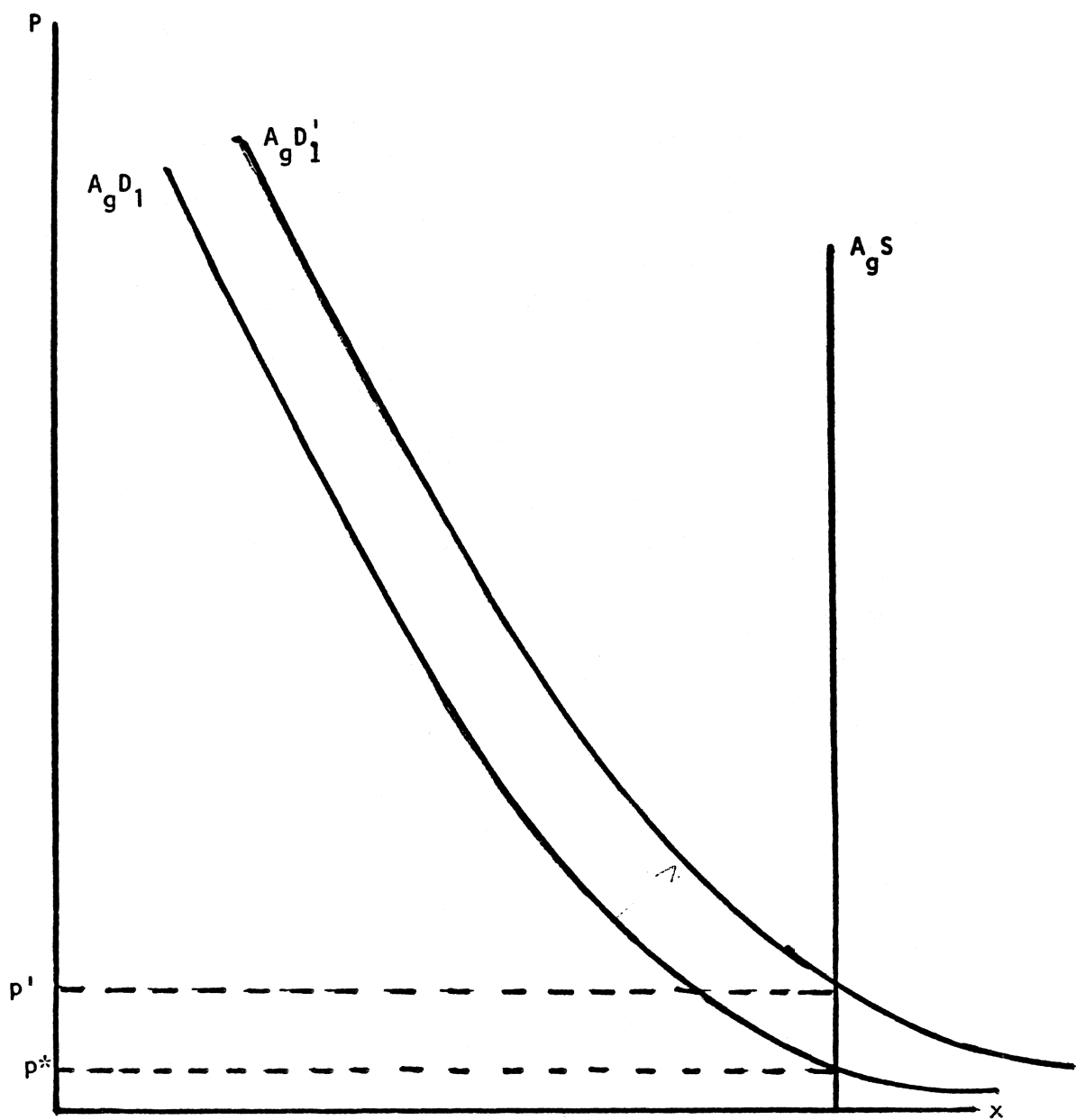


Figure 2

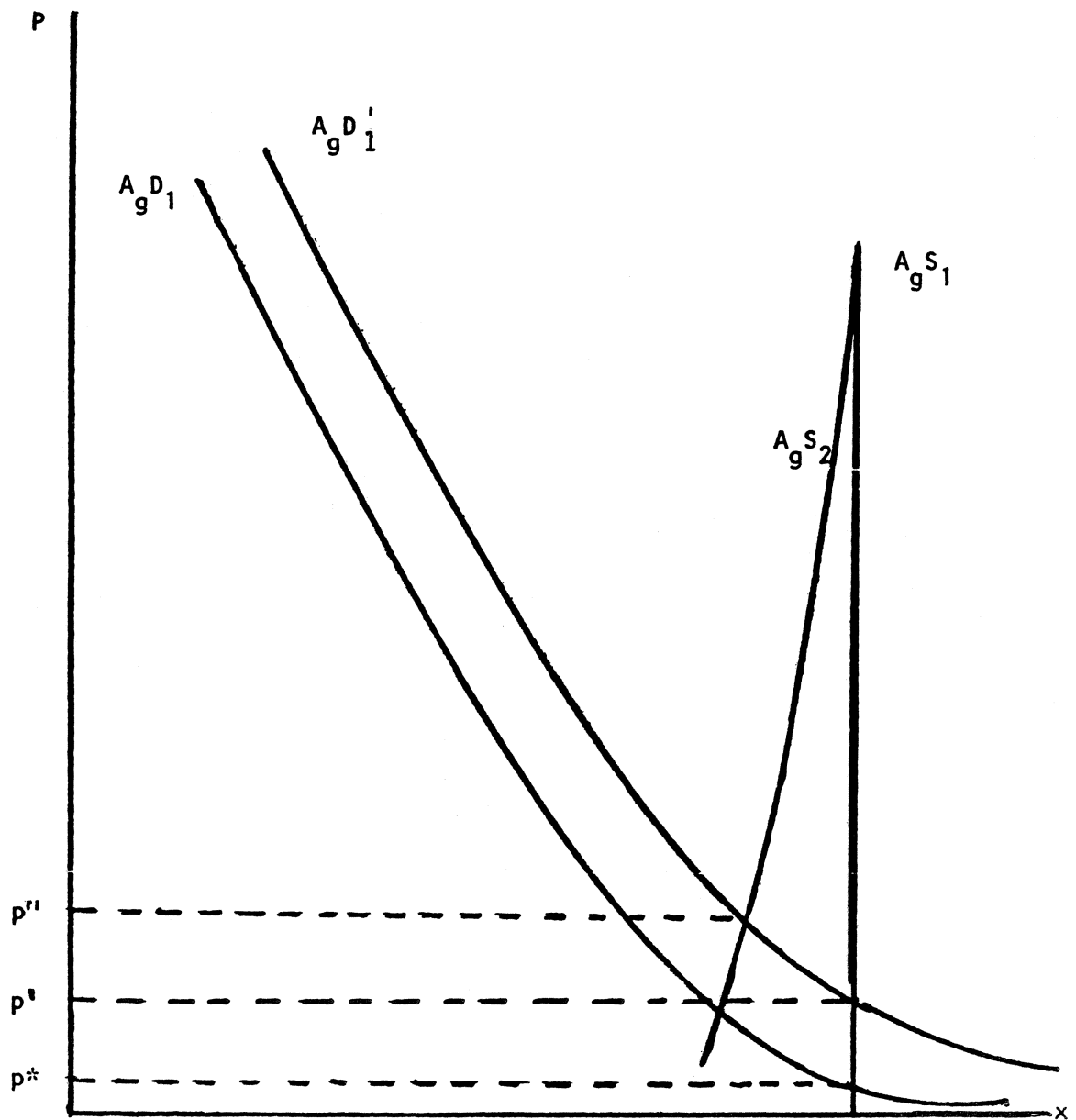


Figure 3